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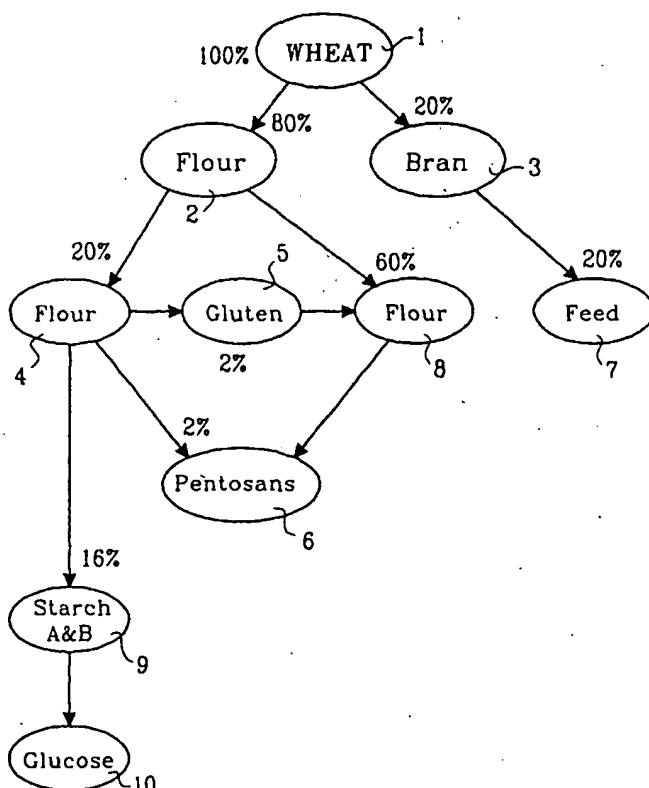
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[Continued on next page]

(54) Title: CEREAL PRODUCT AND PROCESS



(57) Abstract: The present invention relates to a process for the manufacture of a cereal product having an improved protein content and improved baking properties, whereby one mills cereals (1) up to between 50 to 70 % with regard to the kernel (2), that one from a part feed (4) of said flour (2) isolates native gluten (5) and the content of water soluble constituents, such as pentosans (6), that one add the native gluten thus isolated and constituents isolated, such as pentosans, to the remaining feed of flour (8), that the feed (9) of flour being substantially freed from native protein and soluble constituents is used as such, or is further processed such as being subjected to an enzymatic hydrolysis to obtain a glucose syrup (10).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE**CEREAL PRODUCT AND PROCESS****DESCRIPTION**5 Technical field

The present invention relates to process for the manufacture of a cereal product having an improved protein content and improved baking properties.

10 The object of the present invention is to obtain a process for the manufacture of a cereal product having a controlled, improved protein content and improved baking properties, not only based on the improved protein content but also on further baking products based on the same flour.

Background of the invention

15 Wheat which is used to a great extent within the baking industry for the production of different baked products contains a very varied content of gluten. Gluten, which is present in cereals in an amount of some percent up to 18 % (wheat 7 to 18 %) is a protein which contributes to the fact that a baked product, such as bread, sticks together. Gluten provides texture and elasticity to a dough and thereby the baked bread. Variations in the content of
20 the gluten, however, creates large problems within the more industrialized bakery industry which bases its business on given recipes, as well as it provides great problem to large users with defined quality of their baked products. Each product shall behave equally. The cereals oat, barley, and rye develop gluten to a more restricted degree.

25 One demand is thus to have a cereal product, primarily a wheat flour, having a constant content of gluten.

To improve softening and fresh holding properties of a bread malto dextrines are inter alia added today. Addition of individual components is however, costly and quite often,
30 individually isolated components cost a lot, which restricts their use.

One problem to be solved is thus to add such properties to a flour and thereby add them in an optimal way to guarantee the quality of the starting flour.

In order that a bread shall be regarded as tasty it is important that it binds water, as well as it is important from a fresh holding point of view.

In order to improve this feature and to keep an even quality of the flour it is thus requested
5 an addition of a water binding substance.

Cereals are milled to a high yield of flour, i.e., the milling is concentrated on getting as much as possible out of the starch content in the final flour. The cost for this will thereby become very high, as the energy required hereto increases radically with an increased flour
10 out take.

One demand is thus to decrease the costs for milling.

At the milling of wheat the economy is based upon the fact that the milling of a flour
15 amounts of about 70 to 80 % of the kernel, as the remaining bran fraction has a small economical value as feeding product. In order to obtain an amount of gluten which is needed a mill can divide the flour into different fractions in order to mix the different flour qualities later on to a desired end product. The bakery industry requires a stronger flour (higher content of gluten) than what can be utilized at home baking. Thereby quite often a
20 flour having a lower content of gluten is sold to house holds and flour having a higher content of gluten to the bakery industry. If cereals available can not reach the necessary content of gluten, gluten, which has been bought from the starch industry in a dried form, is often added to the flour. However, up to 20 to 25 % of the vital properties of the gluten disappear at drying, which means that a certain over dosage is necessary to reach the desired
25 amount. In particular in parts of the world where it is hard to grow wheat/rye/oat/barley having a high content of protein cereals having a higher content of protein is imported to become mixed with a locally produced wheat. This provides for a better bakery flour than a flour having added dried gluten thereto. At the milling with a high yield of flour part of the aleurone layer (the inner most of four bran layers) will be part of the flour. This increases
30 the protein content of the flour but unfortunately not with a protein which adds to good baking properties. Simultaneously herewith, this protein fractionation diminishes the value of the bran fraction. The protein of the aleurone layer is inter alia rich in lysin and is the protein which has a high nutritional content. Some years large rain falls occur at harvesting

- and harvest can only take place with a high water content. This leads to that a so called low fall number is obtained. This means that the enzyme activity of the flour is high, and that the flour is less suitable for baking purposes. Also this enzyme activity derives primarily from the outer layer of the cereal grain inter alia the aleurone layer. It has thus turned out that two essential advantages can be achieved by milling in such a way that the aleurone layer is not reached. This means in turn that the milling degree is decreased to 50 to 70 % of the kernel. This means in turn that a considerably more simple milling equipment can be used, which in turn reduces the investment need. Further, the energy cost is markedly reduced.
- 10 It is further known to enzymatically hydrolyse cereals, whole cereals or crushed cereals, as well as pure starch content to produce a sweetening syrup such as glucose syrup. Such syrup, carbohydrate composition, has sweetening properties and is suitable for baking purposes and encompasses an enzymatically hydrolysed cereal, such as hydrolysed wheat, rye, barley, oat, rye-wheat (Triticala), sorghum, corn and rice. The hydrolysis can thereby be carried out, starting from crushed whole cereal or flour using an alpha-amylase followed by an amyloglucosidase step to increase the glucose content of the product hydrolysed using the alpha-amylase. The final product comprises in a first step, a viscous maltose product rich in oligo-saccharides having a dry content of about 40 %, and, including step two, a product rich in glucose having a dry substance content of about 40 %. By changing the water content the product can be obtained having a higher dry substance content leading to a higher degree of glucose. A dry product can be produced by spray drying, suitably in a conveyor spray drier. It is known that such hydrolysates have functional properties at baking and contributes thereby to inter alia a better consistency and prolonged fresh holding.
- 25 Thus there exist a number of problems within the bakery industry to be solved, viz. to reduce costs for milling, improved contents of protein to guarantee the quality, improve softening and fresh holding properties.

Description of the present invention

- 30 It has now surprisingly turned out possible to be able to solve these above mentioned problems by means of the present invention which is characterized in that one mills cereals up to a degree of 65 % with regard to the kernel, that one from a part feed of said flour isolates native gluten and the content of water soluble constituents, such as pentosans, that

one add the native gluten thus isolated and constituents isolated, such as pentosans, to the remaining feed of flour, that the feed of flour being substantially freed from native protein and soluble constituents is used as such, or is further processed, such as made subject to an enzymatic hydrolysis to obtain a glucose syrup.

5

Further characteristics are evident from the accompanying claims.

Further, additional features and characteristics and problem-problem solutions will be evident from the following detailed description.

10

By means of the present invention there is obtained a flour, in particular a wheat flour, which shows a very high and even quality which is a prerequisite for a high and even quality of the end product, the baked bread.

15 The term bread hereby means all types of baked products based on flour, independent of it is a plain bread, a breakfast bread, a hamburger bread, crisp plain bread, a pizza dough, a soft cake, or biscuits, and so on.

The present invention will be described more in detail in the following with reference to
20 some different flow sheets, however, without being restricted thereto. In the flow sheets of this drawing

FIG. 1 is a basic scheme over the treatment of cereals according to the present invention;

FIG. 2 is a scheme over the treatment partly according to FIG. 1, partly comprising further process steps;

25 FIG. 3 is a scheme over the treatment partly according to FIG.1, partly according to further, alternative process steps;

FIG. 4 is flow sheet over the treatment of wheat substantially according to FIG. 1.

With reference to FIG. 1 there is shown as an example an ingoing wheat 1, which is milled
30 in such a way that one obtains 60 % of flour 2, and 40 % of bran-flour 3, which later fraction 7 can be used either as a nutritional agent, feeding stuff, or become the starting material of an enzymatic hydrolysis. A third 4 of the flour fraction is then treated in a kneading process using water for washing out ingoing amounts of native gluten 5, which

gluten is isolated. Further, there is obtained together with the wash water, soluble constituents, such as pentosans 6. This solution can be concentrated. Remaining starch 9 which is substantially freed from proteins is fed to a hydrolysing process for conversion into glucose 10. The remaining two thirds of the flour and isolated gluten and soluble
5 constituents, such as pentosans are then combined to a protein enriched flour 8.

FIG. 2 shows a process which substantially corresponds to the basic process according to FIG. 1, but where the bran-flour obtained at the milling, is subjected to an enzymatic hydrolysis, whereby glucose syrup, protein and bran are obtained as end products. Usually
10 glucose syrup and the protein fractions are gathered collected to a starch syrup. The hydrolysis takes place by adding the bran-flour 3 to preheated water (50 to 70°C) to a dry substance content of 20 to 50 % during simultaneous addition of enzymes, alpha-amylase (Ban 240L, (Novo)) and amyloglucosidase (AMG 200L (Novo)). pH is adjusted to 4.5 to 5.2. Heating/maintaining of the temperature of the starting material suspension to 50 to
15 75°C is made during gelatinization for carrying out a complete hydrolysis reaction, complete carrying out of the hydrolysis reaction for a residence time of 3 to 4 hrs, heating to 90 to 95°C for the deactivation of the enzymes present, isolation of the reaction product 14, which contains 50 to 75 % of glucose based on the dry matter content, optionally in combination with evaporation and the separation off of fibres 15.

20 In a preferred process step an ultra filtration of the glucose syrup is carried out, whereby the glucose syrup is filtered at 50°C through an ultra filter having a molecular cut of 20 to 100 kDa, whereby protein 12 present and fats are separated off and one obtains a substantially pure glucose syrup as filtrate. The glucose syrup is then evaporated under vacuo to about 75
25 % dry substance and is thereby so pure that the glucose 13 obtained normally crystallizes with very fine crystals. The glucose syrup is soluble at temperatures over 55°C.

During hydrolysis of flour, starch, residual bread and other such starch containing material using amylase and amyloglucosidase and utilizing ultra filtration the enzymes are kept back
30 in the concentrate while the smaller sugar molecules glucose, maltose, maltotriose can pass the membrane. This leads to that the amount of enzymes added can be used for a longer time period.

The glucose syrup from the enzymatic hydrolysis can be added as well in a non-separated condition, the protein enriched flour 8, in order to thereby add a sweetening agent to the bakery starting material, now called 11 in FIG. 2.

- 5 In a particularly preferred embodiment a part feed of the raw material provided with alpha-amylase is taken out and is brought substantially directly (residence time/reaction time about 2 min) to the inactivation step where this fraction is reunited with the completely hydrolysed raw material feed. By means of this measure partly decomposed starch will be present, which decomposed product comprises inter alia dextrines, which provide better
10 baking properties. The measure further means that a dry substance amount of the hydrolysed starch syrup of 40 to 50 % can be obtained.

- In one embodiment of the invention in accordance with FIG. 3 the starch 9 from the isolation of gluten is hydrolysed to glucose 10, which then is added to the gluten enriched
15 flour 8, whereby one obtains a sweetened flour 16.

With reference to FIG. 4 there is shown an hydrolysis, whereby the glucose syrup obtained is added to the flour provided with soluble constituents.

- 20 With reference to the flow sheet according to FIG. 5 a detail of the process according to FIG. 1 is shown. Hereby wheat is introduced and is moistened with water so that one obtains the optimal milling conditions, normally a humidity of 16 to 17 %. The ground wheat is sieved, whereby a coarse fibre material is obtained in the form of bran, industrial flour and bakery flour including a fine fibre fraction and inner fruit layer. The industrial
25 flour is brought to a mixer and water is added thereto and is homogenized. Then the homogenisate is transferred to a decanter for isolating starch, so called A-starch, and fibres, as one fraction, pentosans as one fraction, and gluten and so called B-starch as one fraction. The A-starch and fibres are sieved to obtain fibres and starch each individually, as well as gluten and B-starch are wet sieved to obtain gluten and B-starch each individually. The A-
30 starch together with process water is transferred to a decanter for the separation of water and A-starch, whereby the water is recirculated as process water.

Addition of gluten in wet form in accordance with what has been stated above provides for a gluten quality similar to that of existing, native natural gluten. An alternative to the above mentioned wet fractionation is to separate off part of the starch in a dry fractionation such as by means of sieving. By milling and sieving part of the starch is sieved off and in that way a
5 higher gluten content can be obtained as well. The bran and flour fraction can be used in different ways, such as it is after dry fractionation, as feeding stuff or food stuff; be hydrolysed and be used wet or dried as feeding stuff or food stuff; separation off of the syrup and obtaining of fibre/protein as one phase, which can be dried or used as feeding stuff or food
10 feeding stuff or food stuff.

The starch which is obtained after the separation off of the gluten can be dried and used as food stuff. The starch can be mixed with the flour to provide for a starch enriched flour, as well.

CLAIMS

1. Process for the manufacture of a cereal product having an improved protein content and improved baking properties,
5 **characterized in**
that one mills cereals (1) up to between 50 to 70 % with regard to the kernel (2), that one from a part feed (4) of said flour (2) isolates native gluten (5) and the content of water soluble constituents, such as pentosans (6), that one add the native gluten thus isolated and constituents isolated, such as pentosans, to the remaining feed of flour (8), that the feed (9)
10 of flour being substantially freed from native protein and soluble constituents is used as such, or is further processed.
2. Process according to claim 1,
characterized in that the flour feed (9) being substantially freed from native protein and
15 soluble constituents is subjected to an enzymatic hydrolysis for obtaining a glucose syrup.
3. Process according to claim 1,
characterized in that the remaining feed obtained from the milling operation and containing fibres-starch flour (3) is subjected to an enzymatic hydrolysis to obtain starch syrup (14)
20 which is added to the remaining feed of flour (11).
4. Process according to claim 1,
characterized in that the starch syrup obtained is fractionated through a decanter, and optionally a separator, and optional ultra filtration into glucose, proteins and fibres.
25
5. Process according to claim 1-2,
characterized in that the starch being freed from native gluten and soluble constituents is subjected to an enzymatic hydrolysis to obtain a glucose syrup.
- 30 6. Process according to claim 1-3
characterized in that a part feed is removed at the enzymatic hydrolysis of the remaining feed of fibres-starch flour (3) to starch syrup, which part feed is only partially hydrolysed using alpha-amylase to obtain a partially hydrolysed product containing inter alia dextrines.

7. Process according to claim 6,
characterized in that the partially hydrolysed remaining feed is reunited with the
completely hydrolysed feed of fibres-starch flour and is then added to the flour fraction (8)
being enriched with native gluten and said soluble constituents.

5

8. Cereal product containing flour of one or more cereals,
characterized in
that it comprises a flour consisting of 50 to 70 % of ground cereals, from the same cereals
isolated native gluten, and water soluble constituents present in said flour, from the same
10 cereals derived starch syrup based on a hydrolysed remaining feed of fibres-flour (3).

9. Cereal product according to claim 8,
characterized in that the hydrolysed starch syrup contains partially hydrolysed starch.

15 10. Cereal product according to claim 9,
characterized in that the partially hydrolysed starch is a partially, using alpha-amylase
enzymatically hydrolysed starch having a content of dextrines, maltotriose, and maltose.

11. Cereal product according to claim 8,
20 **characterized** in that the starch being substantially freed from native protein is dried.

12. Cereal product according to claim 8,
characterized in that the starch being substantially freed from native protein is mixed into a
flour to obtain a starch enriched flour.

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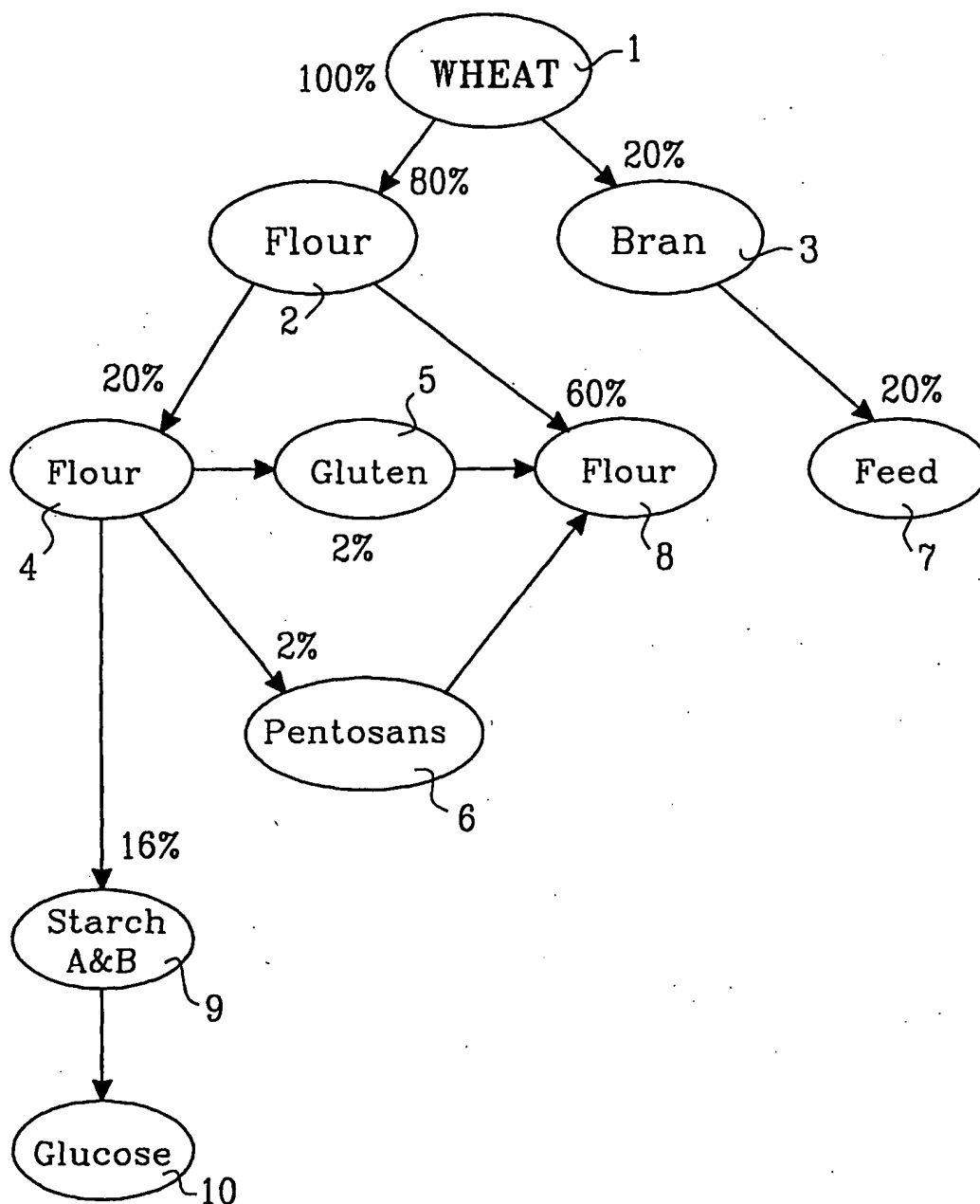


FIG. 1

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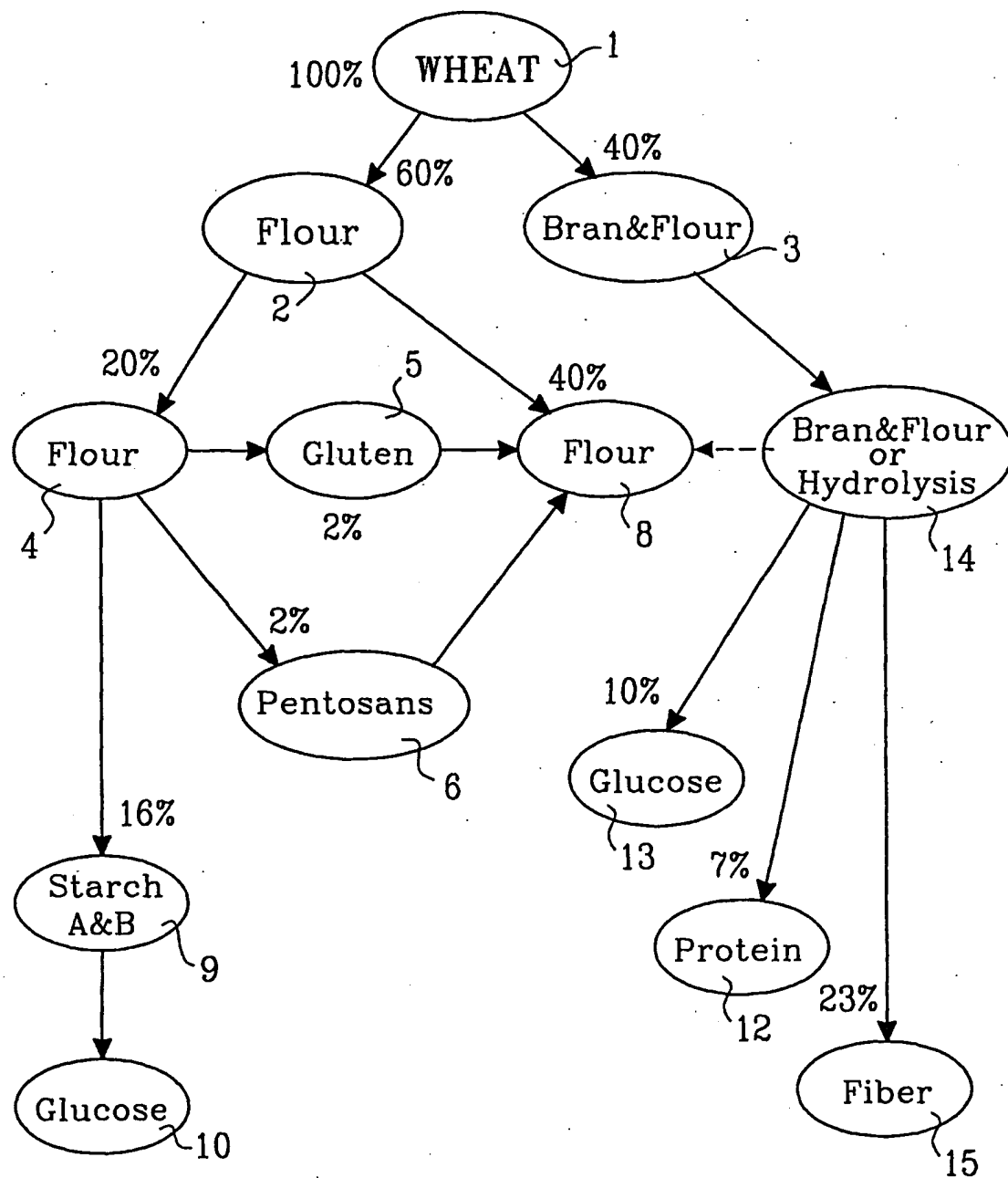


FIG.2

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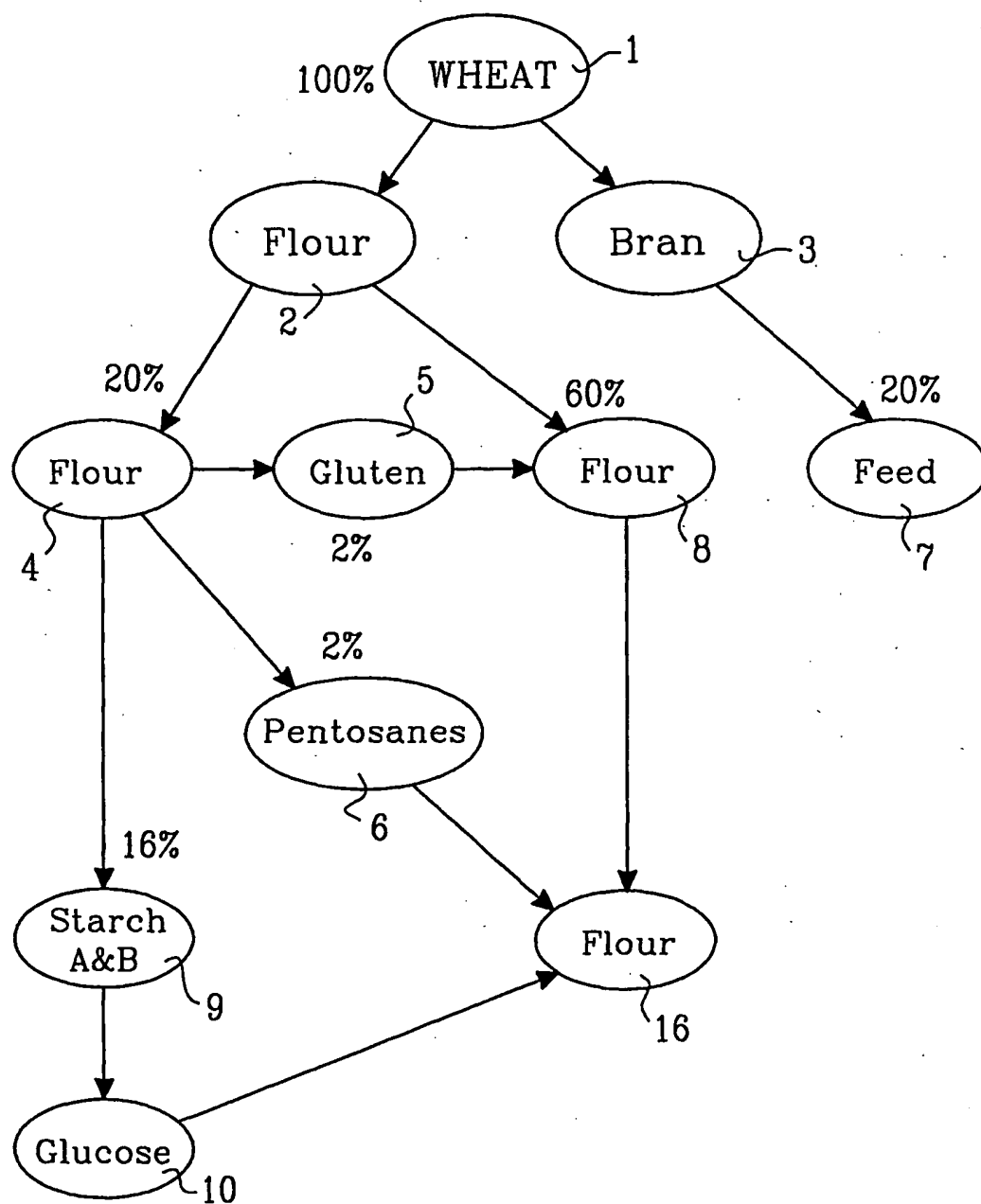


FIG.3

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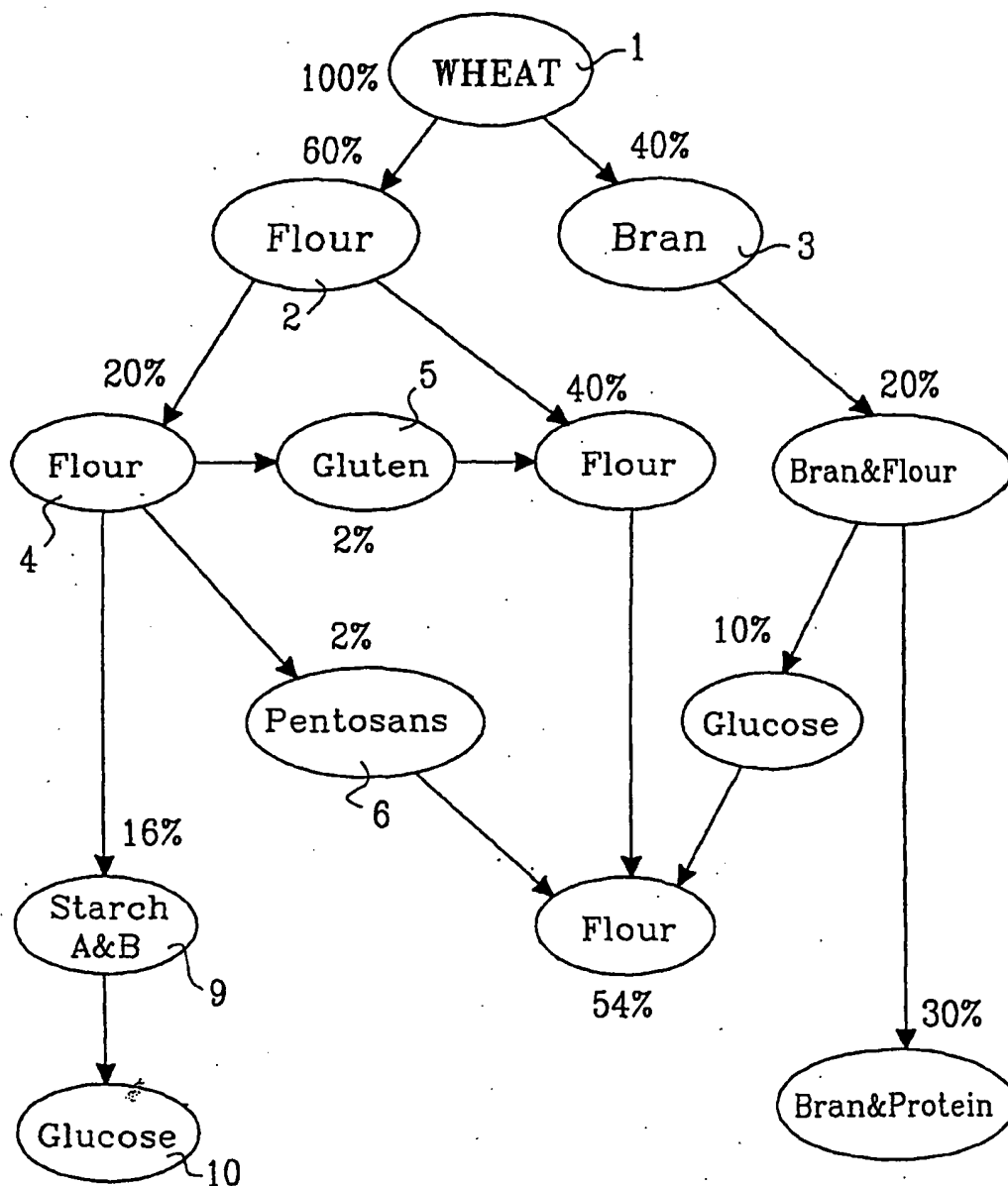


FIG.4

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STARCH PROCESS

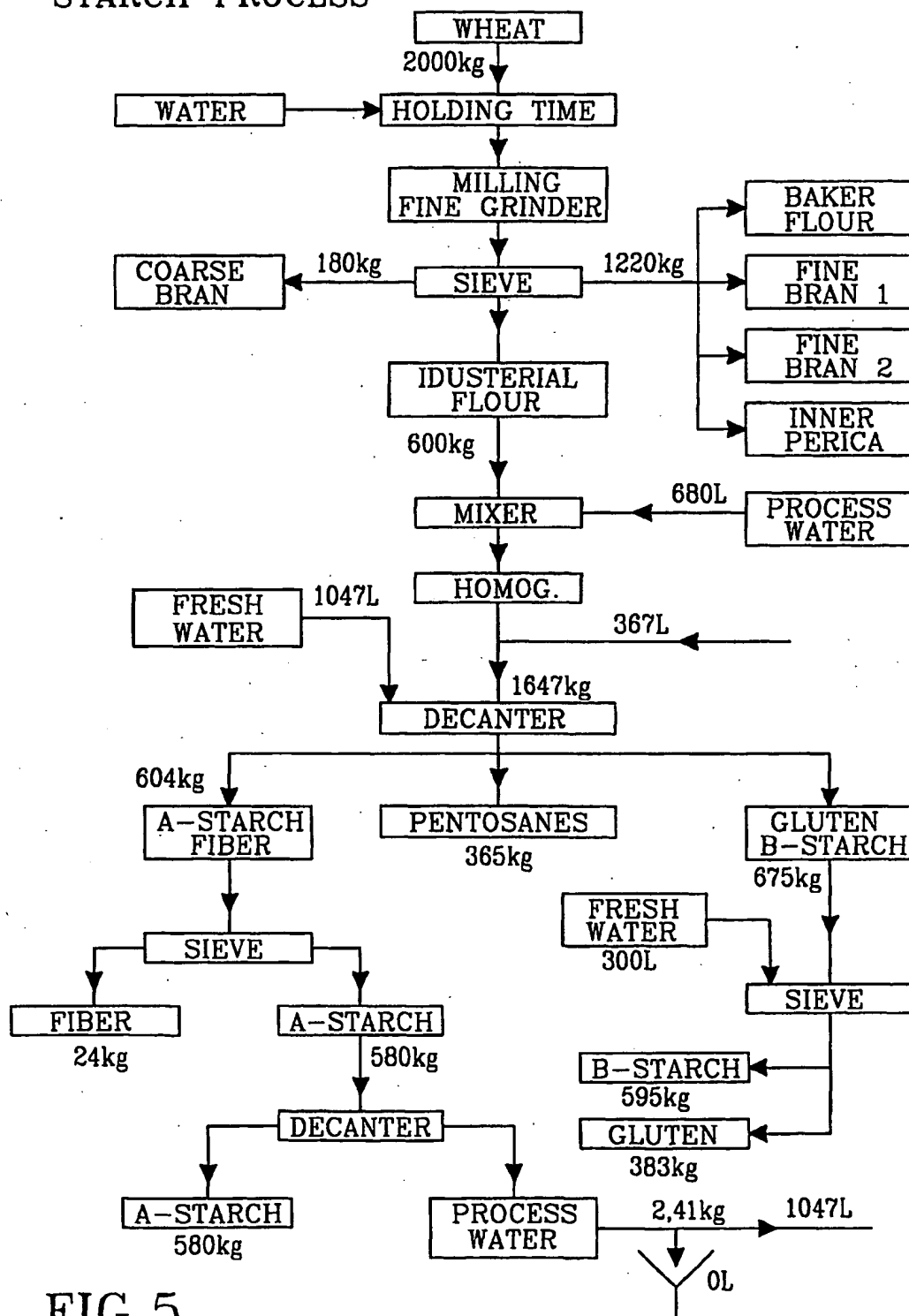


FIG.5

RECTIFIED SHEET (RULE 91)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/00319

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A21D 6/00, A23J 1/12, A21D 2/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A21D, A23J, A21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4248896 A (LELAND C. WALLACE), 3 February 1981 (03.02.81) --	1-12
A	WPI/Derwent's abstract, Accession Number 1990-020534, week 9003, ABSTRACT OF SU, 1457878 (MOSC FOOD IND TECHN) 15 February 1989 (15.02.1989) --	1-12
A	US 4919952 A (GOBIND T. SADARANGANEY ET AL), 24 April 1990 (24.04.90) --	1-12
A	EP 0919294 A1 (HOSOKAWA ALPINE AKTIENGESELLSCHAFT), 2 June 1999 (02.06.99) --	1-92

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/00319

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0221427 A2 (VE KOMBINAT STÄRKE UND KARTOFFELVEREDLUNG), 13 May 1987 (13.05.87) -----	1-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/07/01

International application No.

PCT/SE 01/00319

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US	4919952	A	24/04/90	NONE	
EP	0919294	A1	02/06/99	AT 190875 T DE 59701334 D DK 919294 T ES 2147418 T PT 919294 T	15/04/00 00/00/00 28/08/00 01/09/00 29/09/00
EP	0221427	A2	13/05/87	AT 99700 T AU 594092 B AU 6452386 A BG 47408 A CS 8607017 A DD 258718 A DE 3689509 D HU 44423 A HU 199068 B JP 6048954 B JP 63094942 A	15/01/94 01/03/90 07/05/87 16/07/90 12/01/89 03/08/88 00/00/00 28/03/88 29/01/90 29/06/94 26/04/88